Vol. 87, No. 23, pp. 245–256 22 October 1974

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF HERMIT CRAB OF THE GENUS *NEMATOPAGURUS* (CRUSTACEA: DECAPODA: PAGURIDAE) FROM HAWAII

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The genus *Nematopagurus* was established by A. Milne-Edwards and Bouvier (1892) for *Nematopagurus longicornis* A. Milne-Edwards and Bouvier from the western Mediterranean and eastern Atlantic from Spain to Cape Verde (A. Milne-Edwards and Bouvier, 1892; 1899, 1900). Subsequently, Alcock (1905) assigned *Catapagurus muricatus* Henderson, 1896 from Ceylon to *Nematopagurus* and described four additional species from several localities in the northern Indian Ocean. De Saint Laurent (1968) proposed, without discussion, that Melin's (1939) *Eupagurus* (*Catapagurus*) *vallatus* from Japan also should be assigned to *Nematopagurus*. Recently, Lewinsohn (1969) reported *N. muricatus* and *N. squamichelis* Alcock from the Gulf of Aqaba, Red Sea, and described another new species, *Nematopagurus diadema* Lewinsohn from the same area. The discovery of a new species of this genus from Hawaii is the first record of *Nematopagurus* in this easternmost part of the Indo-west-Pacific Ocean.

This species, *Nematopagurus spinulosensoris* n. sp., described herein, is particularly noteworthy, not only as indicative of the considerable extension of the range of *Nemato-*

pagurus, but because, as its name implies, it possesses certain unique sensory structures, unknown in other pagurids.

The holotype and certain paratypes are deposited in the National Museum of Natural History, Smithsonian Institution (USNM). Additional paratypes are deposited as follows: Bernice P. Bishop Museum (BPBM), Honolulu, Hawaii; Allan Hancock Foundation (AHF), University of Southern California; and Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands (RMNH). A single measurement, the shield length (SL) has been made for each specimen.

The authors are indebted to Dr. Paul J. Struhsaker, National Marine Fisheries Center, Honolulu, Hawaii, for providing specimens from the collections of the National Marine Fisheries Service; to Dr. Chanan Lewinsohn, Tel-Aviv University, Tel-Aviv, Israel, for providing comparative specimens of *Nematopagurus muricatus* (Henderson); and particularly to Dr. Robin M. Overstreet, Gulf Coast Research Laboratory, Ocean Springs, Mississippi, for his serial sections and preliminary interpretation of the sensory structures of this species. This research has been supported, in part, by Research Grant GB 40062 from the National Science Foundation and by a Hawaii Biomedical Support Grant 1970/1971.

Nematopagurus spinulosensoris new species

Figures 1–3

Holotype: ♂ (SL = 8.6 mm), NOAA station TC-33-15, 21°02′N, 156°46′W, 31 October 1967, 241–254 m, USNM 149299.

Paratypes: 1♂ (SL = 5.2 mm), off Oahu, 23 September 1971, 382 m, RMNH; 6♂, (SW = 5.1–7.4 mm), 2♀, 1 ovigerous (SL = 5.2, 6.5 mm), NOAA station TC-33-15, 21°02′N, 156°46′W, 31 October 1967, 241–254 m, USNM, BPBM, AHF, RMNH.

Type-Locality: Off Molokai, Hawaii, 21°02′N, 156°46′W.

Diagnosis: Chelae and carpi of both chelipeds, each with sensory-modified spines on dorsal surface. Right chela with several irregular rows of spines on dorsal surface. Carpi of ambulatory legs each with row of strong spines dorsally.

Description: Shield (Fig. 1a) longer than broad; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections concave; posterior margin truncate or roundly truncate; dorsal surface with numerous tufts of stiff setae; anterolateral angle produced, subacute or acute. Rostrum usually obtusely rounded,

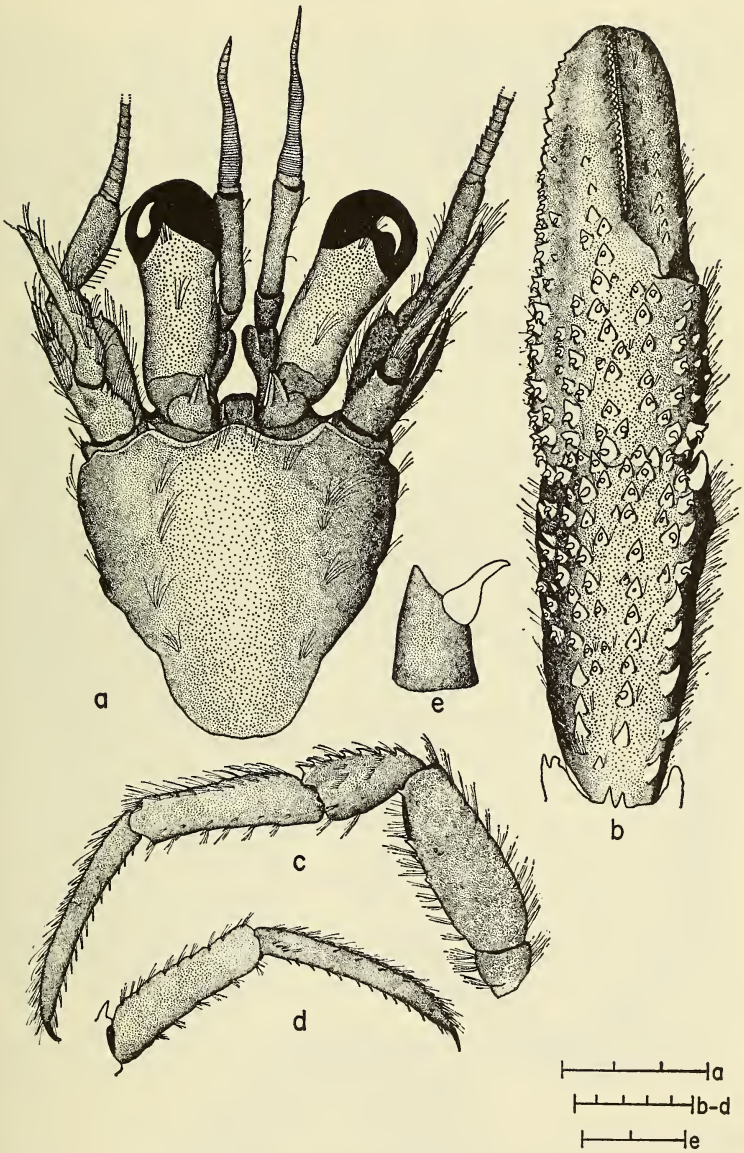

FIG. 1. *Nematopagurus spinulosensoris* n. sp., ♂ paratype: a, shield; b, left chela and carpus (dorsal view); c, 2nd left pereiopod (lateral view); d, 2nd left dactyl and propodus (mesial view); e, spine of chela with sensory process. Scales equal 3 mm (a), 5 mm (b–d) and 0.5 mm (e).

occasionally obtusely triangular; often not exceeding lateral projections, occasionally slightly exceeding lateral projections; usually with few moderately long setae. Lateral projections prominent, obtusely triangular, each with prominent submarginal spine.

Ocular peduncles moderately short, two-thirds to three-fourths length of shield; dorsal and dorsomesial surfaces frequently with few tufts of setae; corneae usually strongly dilated. Ocular acicles acutely triangular, moderately slender, with prominent longitudinal furrow; terminating acutely or subacutely, and with very strong submarginal spine; separated basally by three-fourths to entire basal width of one acicle.

Antennular peduncles moderately long, exceeding ocular peduncles by one-half to two-thirds length of ultimate segment; ultimate segment with longitudinal row of setae on dorsal surface in distal half, occasionally on distal two-thirds to four-fifths; penultimate segment with few scattered setae; basal segment with small spine or spinule at ventrodistal margin, partially obscured by tuft of long stiff setae, lateral face proximally, with very strong, slender, acute spine.

Antennal peduncles moderately short, exceeding ocular peduncles by one-fifth to one-half length of ultimate segment; with supernumerary segmentation (c.f. McLaughlin, 1974). Fifth and fourth segments with numerous tufts of moderately long setae. Third segment with small to moderately strong spine at ventrodistal angle, partially obscured by tuft of very long stiff setae. Second segment with dorsolateral distal angle produced, terminating in strong simple or bifid spine, lateral margin occasionally with small spine distally, mesial face with tufts of long stiff setae and occasionally also with 1 or 2 small spines; dorsomesial distal angle with 1, occasionally 2, small to moderately strong spines, mesial face with long stiff setae. First segment with small to moderately strong spine on lateral face distally; ventrodistal margin with 1–5 small to moderately strong spines. Antennal acicle moderately long, usually reaching beyond proximal half of ultimate peduncular segment; terminating in acute or blunt spine; mesial margin with tufts of long stiff setae and occasionally with 1 or 2 small spines. Antennal flagella long, overreaching tip of right cheliped; occasionally few articles each with 1 or 2 very short setae or bristles.

Mandible without distinguishing characters. Maxillule (Fig. 3a) with proximal endite subquadrate; endopodite with 1 moderately long

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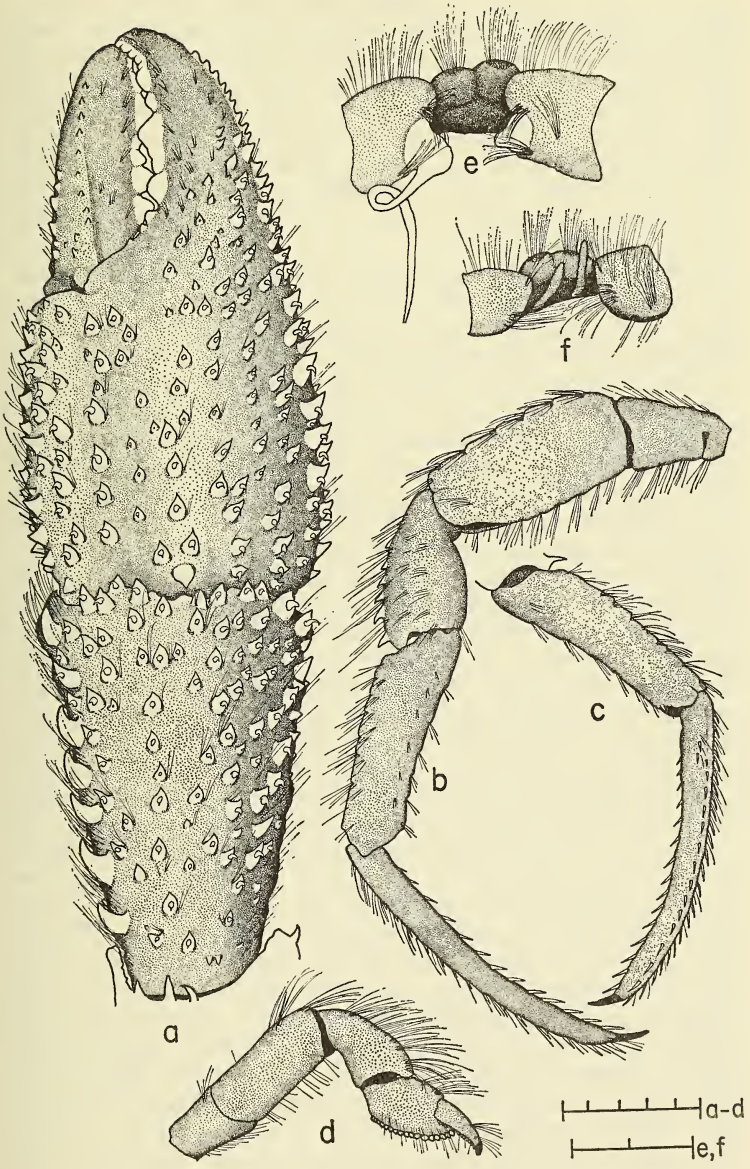
Fig. 2. *Nematopagurus spinulosensoris* n. sp., a–e, ♂ paratype: a, right chela and carpus (dorsal view); b, 3rd left pereiopod (lateral view); c, 3rd left dactyl and propodus (mesial view); d, 4th right pereiopod (lateral view); e, coxae of 5th pereiopods with sexual



tubes (ventral view). f, ♀ paratype, coxae of 5th pereiopods and paired gonopods of 1st abdominal segment (ventral view). Scales equal 5 mm (a–d) and 1 mm (e, f).

bristle on well developed internal lobe, external lobe vestigial or absent. Maxilla (Fig. 3b) with moderately broad endopodite usually equalling scaphognathite in distal extension. First maxilla (Fig. 3c) with basal segment of exopodite very slender. Second maxilliped (Fig. 3d) with basis-ischium fusion complete. Third maxilliped (Fig. 3e) with basis-ischium incomplete; basis usually unarmed; ischium with crista dentata well developed, with accessory tooth; merus with strong spine on dorsodistal margin, ventrodistal angle with cluster of denticulate bristles. Sternite of third maxillipeds unarmed, sparsely setose.

Chelipeds subequal, right usually somewhat larger than left; chelae and carpi of both chelipeds with numerous sensory-modified spines (Figs. 1b, e, 2a) on dorsal surfaces. Right cheliped (Fig. 2a) elongate, moderately slender. Dactyl moderately short, slightly shorter than or equalling length of palm; cutting edge with row of calcareous teeth and usually with few corneous teeth distally, terminating in small corneous claw; slightly overlapped by fixed finger; dorsal surface generally flattened, with few tufts of setae, dorsomesial margin, or dorsal surface mesially, usually slightly elevated and with irregular longitudinal row of unmodified small spines or tubercles, frequently becoming obsolete distally; mesial face with scattered tubercles or spines on proximal third and scattered tufts of setae; ventral surface usually with 3 or 4 rows of tufts of stiff bristles. Palm slender, moderately long, two-thirds to four-fifths length of carpus; dorsomesial margin with irregular single or double row of usually unmodified moderately strong spines, and tufts of long stiff setae; dorsal surface with several irregular rows of usually modified spines, extending onto fixed finger proximally, and scattered tufts of setae; dorsolateral margin with single or double row of moderately strong, usually modified spines, extending onto fixed finger as single row of blunt unmodified spines or tubercles, decreasing in size distally; lateral face frequently weakly tuberculate and with scattered tufts of long stiff setae; ventral surface usually tuberculate, particularly mesially, with scattered tufts of long stiff setae; mesial face with 1 or 2 irregular rows of small tubercles or unmodified spines dorsally and tufts of stiff setae. Carpus moderately long, usually equalling or slightly exceeding length of merus; dorsomesial margin with row of very strong, slender, often curved or hooked, unmodified spines and tufts of long setae; dorsal surface with very irregular rows of moderately strong, usually modified spines, more numerous distally, and scattered tufts of long stiff setae; dorsolateral margin not noticeably delimited, lateral face often with low protuberances and tufts of long stiff setae dorsally and distally, occasionally with moderately strong spines, laterodistal margin with acute spine; ventral surface usually somewhat tuberculate and with numerous tufts of long stiff setae; mesial face with numerous low tubercles or ridges and tufts of stiff setae. Merus sub-

triangular; dorsal margin with irregular row of transverse ridges, often becoming somewhat spinulose distally, and with tufts of long stiff setae, distal margin usually with 2 or 3 strong acute spines; lateral face with scattered tufts of long stiff setae, ventrolateral margin with row of strong, acute, often curved or hooked spines; mesial face usually setose, distal margin and ventromesial face distally with few, small, usually acute spines; ventral surface usually with low tubercles or ridges and tufts of long stiff setae, occasionally with few moderately strong spines. Ischium with strong acute spine at ventrolateral distal angle; ventral, lateral and mesial surfaces setose, ventromesial margin often with few small spines. Coxa with clump of long stiff setae at ventromesial distal angle, 1–3 small tubercles or spinules on ventroproximal angle, ventrolateral margin occasionally with few small spines or spinules, ventrolateral distal angle usually with 1 or 2 acute spines.

Left cheliped (Fig. 1b) moderately long, usually reaching beyond proximal half of dactyl of right; moderately slender, fingers arched or somewhat depressed distally. Dactyl moderately long, one and one-half to twice length of palm; cutting edge with row of small corneous teeth, terminating in small corneous claw; slightly overlapped by fixed finger; dorsal surface somewhat convex, with short row of small unmodified spines or spinulose tubercles usually in midline or occasionally on dorsomesial margin proximally and with 2 or 3 rows of tufts of long stiff setae; mesial face slightly spinulose or tuberculate proximally and with tufts of long stiff setae ventrally and distally; ventral surface with 2 or 3 rows of stiff settae. Palm moderately long, one-third to one-half length of carpus; dorsomesial margin with single or double row of moderately small, frequently modified, acute spines; dorsal surface somewhat convex, midline with 2 or 3 irregular rows of moderately strong, usually modified spines extending onto fixed finger as single row proximally, usually with 1 or 2 irregular rows of modified spines laterally and mesially, occasionally only with scattered spines; dorsolateral margin with double or triple row of small modified spines proximally becoming single row of small unmodified spines or spinulose or blunt tubercles on fixed finger distally, and with long stiff setae; lateral, mesial and ventral surfaces usually somewhat tuberculate and with tufts of long stiff setae. Carpus long, equalling or exceeding length of merus; dorsomesial margin with row of strong, slender, often curved, usually unmodified spines; dorsal surface with 2 or 3 irregular rows of moderately strong modified spines proximally, tending to cluster distally, distal margin occasionally with 1 or 2 spines; dorsolateral margin with single or double row usually modified spines and tufts of long stiff setae; lateral face with scattered modified spines in dorsal half, tufts of long stiff setae ventrally, distal margin ventrally with moderately strong acute spine; mesial and ventral surfaces frequently with low

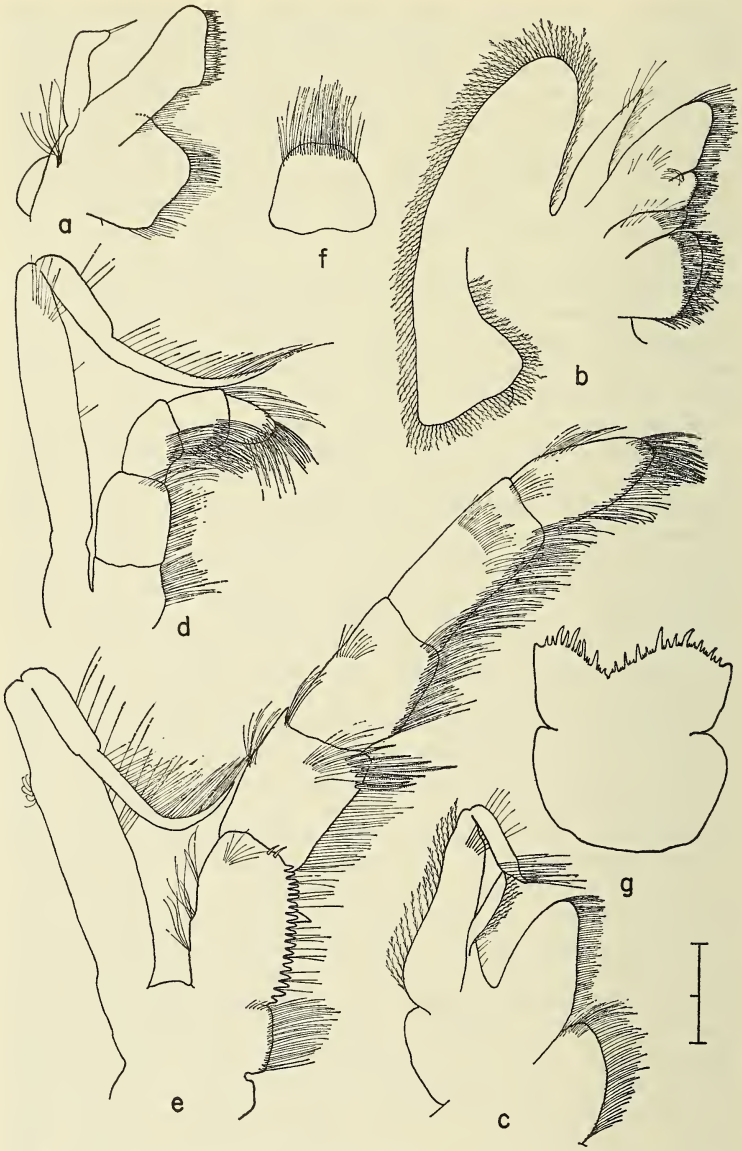


FIG. 3. *Nematopagurus spinulosensoris* n. sp., ♂ paratype, a–e, mouthparts (left, internal view): a, maxillule; b, maxilla; c, 1st maxilliped; d, 2nd maxilliped; e, 3rd maxilliped. f, sternite of 3rd pereiopods; g, telson. Scale equals 1 mm.

protuberances or ridges and tufts of long stiff setae. Merus moderately long, subtriangular; dorsal surface with low transverse ridges, often becoming spinulose distally, and tufts of stiff setae, distal margin with 1–3 acute spines; lateral and mesial faces with low transverse ridges and tufts of long stiff setae; ventromesial and ventrolateral margins each with row of strong, acute, sometimes curved spines. Ischium with row of small spines and tufts of long setae on ventromesial margin, ventrolateral distal angle with acute spine and tuft of long setae. Coxa with clump of long stiff setae at ventromesial distal angle and often 1 or 2 acute spines at ventrolateral distal angle.

Second (Fig. 1c, d) and third (Fig. 2b, c) pereiopods usually overreaching right cheliped, right slightly longer than left, generally similar in structure and armature. Dactyls long, slender, one and one-fourth to one and one-half length of propodi; in lateral view, slightly curved ventrally; in dorsal view, somewhat twisted; each terminating in strong corneous claw; dorsal surfaces each with row of strong corneous spines, increasing in size distally, and tufts of long stiff setae; mesial faces each with faint longitudinal sulcus proximally flanked by 1 or 2 rows of corneous spinules above and few corneous spinules below; lateral faces each sometimes with faint longitudinal sulcus proximally and usually with 1 or 2 rows of tufts of setae; ventral surfaces each with row of strong corneous spines increasing in size distally. Propodi moderately long, one-third to twice length of carpi; dorsal surfaces each with irregular row of transverse ridges and tufts of long stiff setae; mesial and lateral faces usually with 1 or 2 rows of tufts of setae; ventral surfaces each with 1 or 2 rows of tufts of long stiff setae (P_2) or row of small corneous spinules and tufts of long setae (P_3). Carpi two-thirds to three-fourths length of meri; dorsal surfaces each with row of strong spines; mesial and ventral surfaces each with few scattered tufts of long setae; lateral faces each with 1 or 2 rows of stiff setae. Meri laterally compressed; dorsal surfaces each with row of transverse protuberances or ridges and long stiff setae; lateral and mesial faces usually with few tufts of setae, lateral distal margin (P_2) usually with strong acute spine ventrally; ventral surface usually with 1 to several small to moderately strong spines and tufts of setae (P_2) or row of transverse ridges and tufts of long setae (P_3). Ischia each usually with row of long setae on ventral margin and row of small spines (P_2 left). Coxae each with row of tufts of long setae on ventromesial and ventrolateral margins, ventral surface distally also with long setae. Sternite of third pereiopods (Fig. 3f) semisubcircular, anterior margin with long stiff setae.

Fourth pereiopods (Fig. 2d) subchelate; without apparent preungual process; propodal rasp of single row of corneous scales or teeth.

Fifth pereiopods weakly chelate.

Males with well developed, elongate, filiform sexual tube on right coxa of fifth pereiopods (Fig. 2e) left with vas deferens usually

slightly protruded. Pleopods unpaired, pl_3–pl_5 with exopodites well developed; endopodites moderately well developed, smallest on pl_5.

Females with paired gonopores; first pleopods (Fig. 2f) paired, pl_2–pl_4, unpaired, with exopodite moderately well developed, endopodite reduced.

Telson (Fig. 3g) with posterior lobes usually somewhat asymmetrical, left usually slightly larger than right, subtriangular or subquadrate; separated by very shallow median cleft; terminal and usually also lateral margins weakly calcified, terminal margins somewhat oblique, each with numerous small calcareous spines marginally and several stronger calcareous acute or blunt spines submarginally; lateral margins unarmed or occasionally each with row of small calcareous spines or spinules. Anterior lobes unarmed.

Color: In life: Chelipeds and ambulatory legs generally vivid salmon-pink, bordering on iridescent; antennal flagella bright yellow. In preservative: Shield pale orange or straw-colored; ocular peduncles light orange with dark orange ring proximally. Chelipeds very pale orange with white spines; carpi with darker red-orange proximally and ventrally. Ambulatory legs pale orange with lighter longitudinal stripes on dactyls and propodi; carpi pale orange with darker red-orange proximally; meri pale orange and white. Color fading in time to straw-color.

Distribution: Known only from the Hawaiian Islands, 180–250 meters.

Etymology: The specific name, *spinulosensoris*, is derived from the diminutive of the Latin, *spina*, meaning spine, and *sensor*, meaning pertaining to sense, and depicts the sensory-modified spines of the chelipeds.

Remarks: As previously indicated, *N. spinulosensoris* is particularly distinctive in the development of sensory structures on the majority of the spines on the dorsal surfaces of the chelae and carpi of the chelipeds. Although presumed sensory structures are known from several pagurid genera (cf. De Saint Laurent, 1970; McLaughlin, 1974) none of these structures have been asssociated with modifications of the spines. In this species these structures appear as chitinous "tear-drop" like processes, generally on the proximal faces of the spines. Preliminary serial sections have confirmed the sensory character of these processes; however, their fine structure is still under study and will be described in a subsequent report.

N. spinulosensoris can be distinguished from all other species of the genus particularly by the presence of sensory-modified spines on the dorsal surfaces of the chelae and carpi of the chelipeds. In addition, the presence of several irregular rows of spines on the dorsal surface of the right chela distinguishes this species from all others except *N. muricatus*; however, the presence of a row of spines on the dorsal surface of the carpus of each ambulatory leg immediately distinguishes *N. spinulosensoris* from the latter species.

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